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LOCALIZING SYMPTOMS.

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S. G. WEBBER, M. D.,

BOSTON.

[*Reprinted from the Boston Medical and Surgical Journal of March 8 and 15, 1883.*]

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OCULAR SYMPTOMS AS LOCALIZING SYMPTOMS.[1]

BY S. G. WEBBER, M. D.

PARALYSIS or irregular action of the muscles of the eye has been long noticed as associated with cerebral lesions — indeed it would scarcely be possible to overlook such a prominent symptom; but the reference of definite ocular symptoms to definite lesions was not possible till there was a more accurate study of both than prevailed only a few years since. Andral, in 1834, mentions the "deviation of the eye in some one direction," and speaks of strabismus as then most generally observed.

Conjugate deviation of the eyes, and especially when associated with rotation of the head, could not fail to attract notice when seen; as, however, it is generally a fugitive symptom, lasting only a few hours or days, it would often not be seen, and at other times would not be thought important. In 1858 Prevost called attention to this group of symptoms — in cases of lesion of one of the hemispheres, with deviation towards the side where the lesion is situated — in cases of lesion of the cerebral isthmus, towards the opposite side.

This symptom is of comparatively little value as diagnostic of lesion of the hemispheres; it simply reveals that fact. It may occur with superficial lesions, or with lesions of the cerebral substance, becoming more frequent as the lesion is situated nearer the corpus striatum and the fibres radiating from the cerebral peduncle.

When conjugate deviation of the eyes occurs as the result of a lesion of the pons the symptom is more persistent; it is towards the hemiplegic side, away from the lesion in case of paralysis; away from the hemiplegic side towards the lesion in case of spasms; at least this is the classical statement.

[1] Read before the Boston Society for Medical Improvement, February 12, 1883.

So many important nuclei and commissures are grouped together around the pons Varolii that any symptom connected with lesions in that vicinity is an interesting subject to study.

The anatomy of the medulla, pons, and crura, gives valuable assistance to an understanding of the symptoms associated with disease of those parts.

The seventh nerve enters the pons at one side, passes inwards and backwards nearly to the floor of the fourth ventricle to the eminentia teres; the course is not straight but curvilinear. At the eminentia teres the fibres turn downwards, pass just below the floor of the ventricle for a short distance, then turn again, run outwards, forwards, and slightly upwards, to their nucleus, the inferior facial nucleus. Some of the fibres of the facial probably run into a nucleus found at the bend of the nerve as it turns downwards, the superior nucleus of the facial, the nucleus of the sixth nerve.

The sixth nerve or the abducens enters the medulla just at its junction with the pons, and passes backwards through the pons to the above nucleus.

The third nerve enters the tegmentum of the crus cerebri near the upper (anterior) border of the pons. As soon as the nerve enters the crus the fibres separate, some pass with only a gentle curve to the nucleus at the edge of the gray substance surrounding the aqueduct of Sylvius, others spread out in a fan shape, but after passing or crossing the anterior cerebellar peduncle the fibres converge again and enter the same nucleus.

There is a band of longitudinal fibres running near the floor of the fourth ventricle, called the *posterior longitudinal bundle of the tegmentum*, by Huguenin.[1] This bundle of fibres is shown on cross sections by Wernicke,[2] who says [3] that it looks as though a large part of this bundle arose from the nucleus of the third nerve.

[1] Allgemeine Pathol. der Krankheiten des Nervensystems, p. 137.
[2] Lehrbuch der Gehirnkrankheiten, Bd. i., from p. 85 to p. 141.
[3] Page 103.

Duval has made longitudinal sections so as to show the course of the fibres composing this bundle, and has found that they take their origin below from the nucleus of the sixth nerve (Figs. 1, 2), cross the upper branch of the knee of the seventh nerve, then approaching each other they reach the nucleus of the fourth nerve; before quite reaching that nucleus, however, small bundles separate from the internal

Fig. 1.

Fig. 2.

Fig. 1. Longitudinal section, parallel with floor of fourth ventricle; showing the thin bundle of fibres, running from the nucleus of the sixth nerve, in the bend of the seventh, which decussates and is lost at the nucleus of the third nerve. *After Duval.*

Fig. 2. Transverse section, showing the decussation of the same bundles of fibres, and illustrating how they pass into the third nerve without running into its nucleus. *After Duval.*

border of each, decussate and pass forwards (downwards) to join the third nerve. Many more of the fibres of these bundles unite with the fourth nerve. The fibres which pass from the longitudinal bundles to the third nerves form the anterior and internal fasciculi of those nerves.

Huguenin [1] says, in regard to the union of the abducens with the nucleus of the oculo-motor and trochlear, that he has seen, on horizontal section, fibres which, decussating, seem to unite the upper portion of

[1] Allgemeine Pathol. der Krankheiten des Nervensystems, Zurich, 1873, page 170.

the abducens nucleus with the nucleus of the oculomotor nerve.

By the above commissural arrangement is explained the harmonious action of the eyes in lateral vision. It is not necessary here to consider all the advantages of such a relation of nuclei. There are times, however, when it is desirable that the eyes should not act thus together in lateral vision. When it is wished to look at near objects, as in reading, the internal recti must act with each other independently of the external recti. For this purpose these muscles are also supplied with nerve fibres from the proper nucleus of the third nerve without the intervention of the abducens nucleus.

Hunnius[1] gives a diagram of the innervation of the sixth nerve from the brain and its possible connection with the third.

From the cerebral cortex G, G', arises the motor tract, m, m', which conveys the impulse for turning the eyes sideways to the abducens centre, a, a'; these decussate somewhere in their course, probably in the anterior part of the pons. From the abducens nucleus a, a', arises the abducens nerve passing to the external rectus Re, Re'; also from the same nuclei bundles of nerve fibres, which decussate, pass to the opposite third nerves o, o', which innervates the internal rectus Ri, Ri'. Hunnius represents also a centre c for converging action of the two eyes, which is also united with the cerebral cortex. B represents the pons.

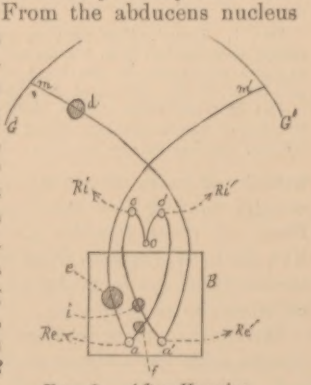

FIG. 3. *After Hunnius.*

In the figure the shaded circles, d, e, i, f, are given

[1] Zur Symptomatologie der Brückenerkrankungen und über die Conjugirte Deviation der Augen bei Hirnkrankheiten, Bonn, 1881.

by Hunnius to represent lesions so located as to give rise to different combinations of deviation, conjugate or otherwise.

A lesion situated as at *d* before decussation of the fibres, innervating the external rectus nucleus, will give rise to the conjugate deviation depending upon lesion of the hemisphere. A lesion after decussation as at *e* or affecting the nucleus of the sixth will produce symptoms the opposite of the former. There should then be in paralyzing lesions conjugate deviation towards the affected limbs, away from the lesion, or if the lesion is irritative there should be spasm or contraction of the opposite limbs with spasmodic deviation away from the limbs, towards the lesion, usually without rotation of the head. A consideration of the diagram will suggest several possible combinations of lesions with symptoms which rarely or never occur. It is possible to have the commissural fibres running from the sixth to the third nucleus affected before decussation, as at *f*, the sixth nucleus escaping; this might give rise to divergent strabismus. It is scarcely possible to have these fibres affected after decussation, and not find the other motor ocular fibres also affected, for the decussation occurs close to the nucleus of the third nerve.

I saw the first case through the courtesy of Dr. Edes, who was at that time in attendance. It is an instance of conjugate deviation of the eyes from paralysis due to lesion of the nucleus of the sixth nerve. There were other symptoms localizing the lesion in the pons, as myosis; the fact that the fifth and seventh nerves were affected on the same side with the limbs, but the sixth on the opposite side, alternate paralysis of the sixth; also the extreme anæsthesia would aid to a diagnosis of locality.

CASE I. HÆMORRHAGE INTO LEFT SIDE OF PONS, EXTENDING INTO CRUS CEREBRI AND BURSTING INTO FOURTH VENTRICLE; RIGHT HEMIPLEGIA AND RIGHT FACIAL PARALYSIS; CONJUGATE DEVIATION TO RIGHT.

A. B. There is a little uncertainty as to the manner in which this patient was first attacked. The most probable history is that he had been accustomed to the use of liquor; once before he had been similarly affected; had headache, though not very severe, preceding the present attack, and suffered just before from vertigo. The day on which he was taken sick he returned home from work at noon, felt badly in his head, and was dizzy; went out to be in the fresh air and to get a cup of tea, and fell. It is not certain that he was unconscious. He was not entirely paralyzed on either side. He was brought to the hospital about five o'clock in the afternoon. There was partial paralysis of the left eyelid; both pupils were rather small and responsive to light, the right a little larger than the left. The mouth was drawn to the left; the tongue was protruded to the right. There was complete paralysis of the right hand and arm, partial paralysis of the right leg. On testing for ankle clonus a tremor was excited in the whole right leg, continuing as long as the toes were held; there was no such action on the left side. Tendon reflex was very slight, if any, on either side; cremaster reflex was present on the left, not on the right; there was no marked abdominal or epigastric reflex on either side. There was no lead line. On being spoken to he apparently heard perfectly well, but was unable to make himself understood. He was able to swallow only liquids in small quantities slowly. On being shown written questions he thought he could see if he had his glasses, but was unable to do so when they were given him. Temperature on entrance was 98.4° F., pulse 64. Urine was normal in color, neutral, specific gravity 1014, albu-

men, a trace; sediment, a little pus, a few hyaline and granular casts.

Three days after entrance he was lying on his back, head in the median line, eyes nearly closed, mouth slightly drawn to the left. He was unable to speak, but protruded his tongue when told to do so, and responded in a limited degree to other requests. Sight was not entirely lost, for he followed the finger with his eyes. The left hand and arm and left leg were moved spontaneously, but the limbs of the right side were motionless. Any motion of the face was confined to the left side, the right remaining motionless. The eyelids were both nearly closed, both could be raised, but not fully. The right pupil was of medium size, and responded readily to light; the left pupil was very small, and responded only slightly to light. The left eye did not turn outwards, but moved with tolerable freedom in all other directions; the right eye could not turn inwards, but moved outwards readily, and upwards and downwards with less freedom. The tongue was protruded strongly to the right. Swallowing was very difficult.

Sensation was seemingly entirely wanting on the right side of the face and in the right limbs; a knife stuck into the right hand or leg gave rise to no sign of pain, but a much gentler prick on the left side immediately excited opposition.

Cutaneous reflexes were absent or very slight on the right, but well marked on the left.

There was, then, paralysis of the third nerve on the right in the fibres going to the internal rectus, weakness on both sides in those fibres going to the eyelids, and irritation of the pupillary fibres on the left. The fifth nerve was paralyzed on the right, not on the left. The sixth nerve was paralyzed on the left, was intact on the right. The seventh nerve was paralyzed on the right as to its lower branches. The hypoglossal was paralyzed on the right. The other nerves of the medulla oblongata could not be satisfactorily examined

on account of the patient's condition. The difficulty in swallowing and talking did not necessarily arise from paralysis of those nerves, though it might be so. The limbs were totally paralyzed on the right both as to motion and sensation. Reflex action was seriously impaired or lost on the right.

The temperature was rather high during the first few days; it then was nearly or quite normal, once a degree below normal, and again ran up to 105° F. at the time of his death.

A lesion of the hemispheres is rarely, if ever, accompanied with such serious disturbance of sensation as was found in this case. This feature would limit the locality of the lesion to the crus cerebri or pons or medulla, that is, it must be below the anterior extremity of the crus.

Both the seventh and fifth nerves were paralyzed on the same side as the limbs, therefore the lesion must be above the origin of those nerves, that is, above the middle of the pons.

There was conjugate deviation of the eyes towards the right, partial ptosis on both sides, great contraction with very slight mobility of the left pupil. Conjugate deviation of the eyes towards the sound side in hemiplegia of cerebral origin is not very rare when the hemispheres are affected, and in that case the head is usually turned in the same direction; as Prevost said, the patient seems to be trying to look at the lesion in his brain.

Conjugate deviation of the eyes towards the hemiplegic side has been found heretofore only in cases of lesion of the pons. Nothnagel says that persistent unilateral myosis is found in disease of the pons, and on the same side with the lesion. When the sensation of the limbs is seriously impaired in lesions of the pons it is the external portion which is affected rather than the median.

From these data a diagnosis was made locating the lesion in the anterior and outer portion of the pons.

As to the nature of the lesion, the mode of onset excluded all those which, commencing almost imperceptibly, gradually extend and increase in severity, such as interstitial changes and tumors, excepting the rare cases in which tumors are latent, till a sudden apoplectic attack shows their presence. This is so rarely the case that practically it may be excluded unless further consideration should oblige a return to it.

Hæmorrhage and embolism habitually give rise to apoplectiform attacks. Three symptoms or groups of symptoms will enable us to exclude the latter, — there were prodromic symptoms, — headache, vertigo for some days preceding the attack, and these sensations rather more severe just before it occurred; the loss of power was not most marked immediately after the shock, but the dullness and paralysis steadily increased from the first. There was no record of his temperature until some hours after the attack, but from the time it was first taken there was a rise, interrupted by a slight fall towards midnight. This rise was more steady and higher than would probably be found in embolism. Considering the locality of the lesion the chances are in favor of a hæmorrhage; if the basilar artery were plugged it was probable that death would have resulted sooner, that the symptoms would have been less markedly unilateral; also an embolism of that artery is very rare, and an embolism of its branches is much more rare. For these reasons a diagnosis of hæmorrhage was made occurring primarily in the anterior and external portion of the pons, but as the symptoms had been steadily increasing in gravity it was thought that the blood had torn up the tissue of the pons to a certain extent around the original focus.

Autopsy made by Dr. Gannett. Only the head was examined. The pia mater was of the usual thickness. Both vertebral arteries about three centimetres before uniting were dilated to about twice their usual calibre, their walls at these points were thickened and of an opaque yellow color. The lateral ventricles each con-

tained about five cubic centimetres of clear fluid: the ependyma was everywhere smooth and shiny. The brain substance in general was quite firm, puncta cruenta well marked. The gray cortex of its usual color and thickness. Nothing unusual was observed on section of the basal ganglia except a small hæmorrhage into the inner portion of the outer capsule. The anterior half of the left side of the pons was represented by a soft, semi-fluid, red mass; in its posterior half only the outer portion of the pons presented this appearance. The outer portion of the anterior part of the left side of the medulla presented the same appearance. The hæmorrhage extended also into the left crus cerebri and left crus cerebelli, and had burst through the floor into the fourth ventricle just anterior to the acoustic striæ on the left side. This hæmorrhage was confined entirely to the left side; it did not quite reach the median raphe of the pons, and, judging from the condition of the tissues, it probably began in the outer and anterior portion of the pons.

CASE II. TUMOR OF LEFT CEREBELLUM AND LEFT SIDE OF PONS; DEGENERATION OF LEFT SIXTH NUCLEUS; CONJUGATE DEVIATION TO RIGHT; PARESIS AND SPASM OF LEFT LIMBS.

Mr. R. B., aged sixty, was seen with Dr. Chase, of Dedham, June 9, 1882. He had always worked hard, and had occasionally had headaches till about eight years ago; from that time he had worked harder than ever. Three years ago he had trouble from overwork. The commencement of his illness was referred by the patient to three months before he was seen, but before that his wife noticed that he was less steady than formerly, that buttons requiring the use of the left hand were buttoned with greater difficulty. The patient first noticed that his legs were weak, and that he could not walk well; this difficulty in walking increased, but he was not laid up. He also found trouble in using his mind; having been very skillful in figures he was

not able to perform the problems he desired to work out. His left side gave him the most trouble. He had been confined to bed only two or three weeks. He had had severe headaches, during which his head was drawn down towards the right shoulder, and his face was turned to the right; there had been dizziness, but no nausea. The left arm had been affected with tremor, and at times the whole body also.

When seen he was in bed, head turned to the right, and the eyes to the right: he could move both eyes to the left, but it was with a jerking motion, and not so far as normal. The left eye, following the finger with the right eye closed, moved towards the left very badly; the right eye, with the left closed, moved better than the left. The pupils were equal, reacted to light normally. The left lids moved less readily, and shut less tightly than the right. The left side of the face was slightly paralyzed: the tongue was protruded straight; the left arm was weak and not useful; when raised above his head a tremor commenced when it was about on a level with the shoulder, and this increased as it was raised higher, and became of wider excursion till it resembled choreic motions. In ordinary positions there was scarcely if any tremor; the arm could not be used so readily as the right. Both legs moved fairly well without tremor. Cutaneous reflex was normal; tendon reflex could not be tried satisfactorily as he could be raised only for a very short time for ophthalmoscopic examination; the change of position caused very great vertigo, and could be maintained only a minute or so. Sensation was diminished on the left. The fundus of the eyes was normal. There had been no loss of consciousness. The symptoms came on gradually.

Autopsy. — Dr. Cutler made the autopsy and has furnished the following notes: There was atheroma of the arteries at the base, most marked on the right of the basilar, and there it seemed to encroach upon the calibre of that artery and to interfere with some of the

smaller vessels arising therefrom. On both sides at the end of the carotid there was atheroma, most on the right, and extending on that side into the middle cerebral. The right posterior cerebral was nearly occluded, but a fine stream of water could be forced through it. There were many smaller patches of atheroma dotted over the vessels of the circle of Willis.

The two hemispheres were adherent along the longitudinal fissure; this was probably inflammatory. The pia mater was moderately full of blood; no thickening except along the longitudinal fissure. On section the puncta cruenta were well marked. There was nothing abnormal in the hemispheres.

A little anterior to the middle, the pons was slightly softened; a little lower the tissue became striated, alternate yellow and gray, was somewhat translucent, resembling in color edematous connective tissue; this mass of abnormal tissue was irregularly oval, hard to the touch, and extended with a sinuous course into the left cerebellar lobe; the left corpus dentatum was obscured by it. In the pons the new growth extended nearly to the medulla, being confined to the left side.

One sixth nerve was atrophied.

The other organs were essentially healthy.

The specimen, as I received it from Dr. Cutler, had been some time in alcohol, and I was not willing to wait long enough to see whether it would harden well in Müller's fluid. The sections for microscopic study were not so continuous and satisfactory as could be wished; but the most important parts showed well. The tumor had no clearly defined edge towards the pons, yet it could be seen that the deep nucleus of the seventh nerve was not destroyed, but just external to that nucleus the seventh nerve passed through the tumor and must have suffered in its conducting power in that part of its tract; at least that would explain the facial paralysis on the left. Anterior to the nucleus of the seventh nerve the tumor apparently approached nearer to the median line.

A large proportion of the nucleus of the left sixth nerve was healthy. In one section through the middle of the nucleus there were many degenerated nerve cells, and the number of cells was evidently less than that on the right of the same section.

The diagnosis at the time the patient was examined was tumor in the basal ganglia or cortex on the right or in the pons on the left, possibly implicating the cerebellum. The latter was considered the more probable.

Besides the conjugate deviation of the eyes the peculiar irregular motion on raising the left arm is worthy of notice. It is also of interest that there was such extensive change of the cerebellum and of part of the pons, yet no retinitis was present. The vertigo might have been expected, as it is a common symptom in cerebellar tumor. The fact that the head was drawn towards the right shoulder during the severe attacks of headache is also of interest.

The symptoms in this case are peculiar, but seemingly are easily explained. The tumor, as shown on section, did not affect the great motor tract of the pons, the pyramidal fibres which run near the anterior border of the pons, hence we have no paralysis of the right side. The facial nerve runs through the tumor, and that nerve was partially paralyzed. The tumor was situated in the left middle cerebellar crus, and extended into the pons. The specimen had been long in alcohol when I received it, and it was cut so that exactly how much of the pons was affected I could not say with certainty. Brown Séquard has shown that lesions in this vicinity may give rise to partial paralysis on the same side with the lesion; hence the weakness of the left limbs. The spasm developed in the left arm by raising it cannot be readily explained; it was very much like the phenomenon known as post-hemiplegic chorea. The conjugate deviation was away from the side of the lesion. But in this case the regular order of symptoms was broken, for there was weakness and spasm of the left side, that on which was the tumor,

and the deviation was towards the opposite side. In this regard the case is anomalous.

The third case was one of temporary, intermittent paralysis with conjugate deviation. As the symptoms were described to me at first, without seeing the patient, I ventured to guess that it was a case of epilepsy, and suggested the use of bromide of potassium until I could see her a day or two later. This drug did not give relief, and when the patient was seen and carefully questioned and examined, it seemed possible that the symptoms might come from local disturbance of circulation, or that there was some small spot of degeneration.

The result supports the view that the early symptoms were caused by a disturbance of the circulation, continuing only a short time, and that then the blood took again its normal course. The extensive atheroma of the arteries, and the great change in the basilar and its branches, renders such a temporary interruption of the circulation quite probable.

Benjamin Ball[1] reports cases of paralysis which he thinks were due to "contraction of the vessels supplying certain provinces of the encephalon, without structural change, either in the vessels themselves or in those parts of the brain the functions of which were momentarily suspended." He thinks this "spasmodic contraction of the brain vessels may persist for a considerable length of time without producing structural changes in the nervous centres," and that "the morbid condition may, in certain cases, suddenly disappear, while it is not unreasonable to suppose that the converse may be equally true, and that the symptoms may culminate in rapid or even sudden death."

[1] British Medical Journal, October 30, 1880, page 695.

CASE III. INTERMITTENT LEFT HEMIPLEGIA, WITH CONJUGATE DEVIATION TOWARDS LEFT; DISEASE OF ARTERIES, PLUGGING OF BASILAR; SOFTENING IN PONS AND CEREBELLUM.

Mrs. A., aged about seventy, had been very well all her life, though during three years she had had considerable worry and anxiety as well as grief in the sickness and death of children and husband. Three months before she was seen she was suddenly attacked with flushing of the face and a sensation as if she was about to faint; she sank into a chair; the left arm became powerless, there was a tingling sensation in the hand, and then motion was restored; there was no loss of consciousness. The same day she had another similar, though less severe attack; after that none for several days. They recurred at varying intervals, were lighter, but became more frequent; they had the same characteristics; there was no pain, and no loss of consciousness. After the attack there remained a tingling or numb sensation in the fingers.

There was no paralysis of the leg, simply a slight weakness; once or twice there was tingling in the left leg. Only once was it thought by a daughter that the right side was affected and the left not.

The left side of the face was paralyzed, at least in some of the attacks, the eyelids closed, the left eye turned outwards.

During the attack she could articulate; many of them occurred in the night or early morning, some during the day.

When seen there was nothing abnormal to be noticed in the motions of the eyes, pupils, face, tongue, or hands; she did not walk very firmly, but there was no unsteadiness; sensation was normal; the ophthalmoscope showed no change in the fundus of the eye.

A week later she was worse, had had several severe attacks of paralysis on the left side, then both eyes were turned to the left, the lids were closed most of

the time; no observation was made as to whether she could move her eyes to the right. The left hand continued to feel numb all the time, even between the attacks. Once all four limbs were paralyzed, and she was unable to speak; a dose of whiskey seemed to restore motion and speech.

Finally, during Thursday night, she had an attack, the respiration became stertorous, the paralysis varied from side to side, sometimes the right side seemed paralyzed; the eyes did not deviate; Cheyne-Stoke's respiration for twenty four hours, then it was regular in rhythm, but shallow; the next morning she seemed to recognize some who were about her; Saturday she died.

The autopsy was made three days after death, with the assistance of Dr. Broughton. The skin was very yellow generally. Dura mater was very adherent to the skull; the convolutions of the brain were shrunken, but not more than might be expected; the space left by this shrinking was filled by serum in the meshes of the pia mater, which was not thickened. There was a deeper depression at the upper part of the right anterior central convolution than elsewhere. No adhesions of the pia anywhere. The arteries at the base were very generally atheromatous, but seemingly not more so on one side than the other. The basilar artery, at about its middle, was entirely plugged up by a firm, light colored clot; there was no coagula either side of this clot, indeed, very few coagula were found anywhere. For one inch in length the basilar artery was very atheromatous, and gave off only small branches, excepting one rather large running to the left, which, however, was nearly closed by the atheromatous thickening of its walls.

Both crura tore easily in taking out the brain, and seemed softened; the upper and anterior portion of the left lobe of the cerebellum was very soft; in the right half of the pons, just anterior to the fifth nerve, and apparently among the pyramidal fibres, was a discolored

softened spot. At this point in the pons, and more markedly in the softened tissue of the cerebellum, the microscope showed granular corpuscles about the vessels and in the nervous tissues, also fat corpuscles about the vessels. The crura cerebri were not changed.

The posterior lower portion of the lower lobe of the right lung was dark red, solid, without air, the vessels pervious.

The aortic and mitral valves contained extensive calcareous deposits, the edge of the mitral valve was thickened, and contained a very large amount of this deposit.

The kidneys had thin cortices, the capsules were slightly adherent; post-mortem staining. Spleen small. All other organs normal. The blood was very fluid, and there was much post-mortem staining of the viscera.

After hardening the specimens, thin sections were made through the diseased portion of the pons. The hardening was not entirely satisfactory, as the specimen was put into alcohol a little too soon. The spot of softening in the pons (Fig. 4) was about one half inch in its longest direction, and about one eighth in transverse direction; it was situated obliquely, near the middle of the right half of the pons, not quite reaching the median line, not implicating the sixth nucleus. On section, parts of the altered tissue fell out, leaving ragged edges. In several spots the blood-vessels were very prominent from the débris having partly fallen away from them. In many places the axis cylinders were enlarged. This softened spot did not extend quite to the point where the fibres of the sixth nerve cross the pons.

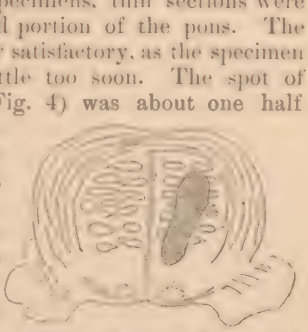

FIG. 4. Showing the size and location of the spot of softening in the Pons. Natural size.

The localizing symptoms were very few; probably had she been seen during one of the attacks more positive symptoms would have been noticed. There was left hemiplegia, with conjugate deviation of the eyes to the left, at least in some of the attacks. This would indicate lesion of the pons, and such a lesion was found. It is not possible to explain the intermittent nature of the symptoms, unless we suppose that at first there was simply a change of blood supply, and when the circulation was restored there was an intermission in the deviation; later the vessels became more occluded, and then the destruction of tissue took place, yet not over an area sufficient to cause permanent deviation; finally the vessels were affected on both sides, and so there was no deviation.

CASE IV. OCCLUSION OF LEFT POSTERIOR CEREBRAL ARTERY; CONGESTION AND SOFTENING OF NUCLEUS OF SPINAL ACCESSORY AND PNEUMOGASTRIC; PARTIAL PARALYSIS OF OCULAR MUSCLES ON THE LEFT; AT LAST CONJUGATE DEVIATION TOWARDS RIGHT.

Annie W., aged seventy, was admitted to the City Hospital December 6, 1881. Her mind seemed clear, but she could not speak above a whisper. Said she could talk aloud one week ago, that she had been sick about ten days. There had been no injury. The mouth was drawn slightly to the left; the tongue was protruded straight; there was less power in the left arm than in the right; there seemed to be less power in the right leg, and sensation was almost wholly lost in that leg; the reflex action was exaggerated in the left foot; striking the bottom of either foot caused severe pain. Incontinence of urine. Slight œdema of ankles and feet.

The next day when seen she could not make herself readily understood. Tickling the eyelids caused reflex action in both lids; both pupils were small, the right smaller than the left; the left lid drooped; motion of

the eyes was somewhat restricted towards the left. The tongue was protruded straight. There was little power in moving either hand, attempts at voluntary motion resulting only in tremor; passive motion of right arm showed a contraction of the muscles of that arm, and caused pain; there was no contraction of the left arm; passive motion of right foot also caused pain and a tremor afterwards; no ankle clonus; on irritating soles of feet the left was slightly withdrawn, the right not at all; there was slight hyperæsthesia to pressure over the legs. After being aroused she quickly relapsed into a semi-comatose condition.

The third day the inequality of the pupils was more marked. She could move both hands, the right better than the left; there was still great tremor on making an effort at voluntary motion.

The fourth day it is noted that the eyes could turn to the left, not to the right. The nurse reported spasm of the fingers and disturbance of respiration. In the the afternoon she died.

Autopsy by Drs. Cutler and Gannett. The left posterior cerebral artery was atheromatous from its origin to its junction with the posterior communicating; it was very much smaller than the right, and seemed to be impervious to blood; air could not be blown through it. The left posterior communicating was much larger than the right; all the other arteries of the brain were healthy, and rather full of blood.

The left side of the pons from about midway between the origins of the fifth and seventh nerves was flattened anteriorly as compared with the right side. The left crus cerebri was apparently smaller, and its foot less distinctly striated than the right, and had generally a softer appearance. On section of pons and crura the antero-posterior and lateral diameters on the left side were diminished as compared with the right. All other parts of the brain were normal.

The heart was healthy, and no change could be discovered which was likely to give rise to an embolus.

The thoracic aorta contained several atheromatous patches.

No recent disease in lungs or elsewhere in thoracic or abdominal viscera.

After hardening it was seen that the blood-vessels of the medulla, pons, and crura cerebri were unusually full of blood, especially those belonging to the gray substance, so full that even the smallest vessels were distinct as if injected artificially. A portion of the gray substance about the aqueduct of Sylvius was very easily broken down, and good sections could not be made through it. This friable portion did not include much of the nucleus of the third nerve; wherever that could be examined the cells seemed to be normal in character and number. A very few small hæmorrhages were to be seen to one side of the third nucleus or in the tegmentum of the crura.

The region of the sixth nerve and its nucleus showed much injection of the blood-vessels. There was no discoverable change in the nerve cells of the nucleus. Just internal to the left eminentia teres, the descending portion of the facial, was an enlarged blood-vessel, with a greatly dilated perivascular canal. This enlarged vessel was much larger than any usually found in that position, and had pressed the seventh nerve out of place. It commenced a few sections below the nucleus of the sixth nerve, and could be followed for a distance above where all traces of the sixth nucleus were lost. Was this the course taken by the blood in the collateral circulation to supply the plugging of the posterior cerebral?

A hæmorrhage was to be seen in the nucleus of the spinal accessory, and around this the nerve tissue was friable, and sections were more or less irregularly broken; the hæmorrhage and irregularly broken masses included on one section at least the whole of both accessory nuclei. The hypoglossal nuclei were seemingly normal.

A section made somewhat higher, so as to include

the vagus nucleus (Fig. 5), showed a similar friable condition for a short distance on each side the median fissure in the floor of the fourth ventricle. There

FIG. 5. Showing injection of small vessels in vagus nucleus. At upper part of figure the tissue is softened. At lower part the hypoglossal nucleus is seen in normal condition, magnified eleven diameters, then reduced one-third.

were a very large number of pigmented cells along the borders of the vagus nucleus; such cells are normally found here, and the patient's age may account for the number. The vessels within the limits of the vagus nucleus and along the gray substance lining the floor of the fourth ventricle were very full and prominent. This congestion did not extend into the hypoglossal nucleus. On the left, near the median fissure, blood had escaped from a vessel just under the floor of the fourth ventricle; possibly this was a continuation of the small hæmorrhage seen at a lower level.

A section a short distance above this was normal.

The diagnosis made during life was — lesion involving the nucleus of the left third nerve; probably obstruction of the left posterior cerebral artery. This diagnosis was made from the fact that there was a decided difference in the two eyes. The left eyelid drooped; the left pupil was the larger. My impression is that the restriction of motion was greater than the record implies, and was much more marked with regard to the left eye than the right, and the conjugate deviation towards the right was a later symptom.

It was supposed that the lesion was recent, and was connected with the cause of death. Having no previous knowledge of the patient this was not unreasonable.

The autopsy showed no gross change in any organ as cause of death. The occlusion of the posterior cerebral artery was evidently an old lesion, and probably the ocular symptoms were also of long standing.

The congestion and softening found in the medulla must be considered as the cause of death. The small hæmorrhages may have occurred only towards the close of life. The changes in this region implicated the most vital nerve nuclei, the spinal accessory and pneumogastric.

On the last day of life the respiration was disturbed. The nature of the disturbance was not learned.

The temperature rose almost without interruption, till the morning of the day on which she died it was 103.5° F.

There was no definite lesion found to explain the conjugate deviation. Sections were made through the whole of the sixth nucleus, twenty or more, and each one carefully examined. The deviation was probably due to disturbance of blood supply, or to the plugging of some vessels which gave rise to no marked change of structure.

Kahler and Pick report[1] a case somewhat similar to this. There had been ocular symptoms pointing to

[1] Arch. f. Psych. u. Nervenk., x., 1880. p. 334.

lesion of the third nerve for several months preceding death. Death resulted from cerebral haemorrhage in another part of the brain. A spot of softening was found in the right tegmentum implicating the fibres of the third nerve as they passed from their nucleus.

The same authors report [1] another case with left hemiplegia, left facial paralysis, right ptosis, and paralysis of the right rectus superior and inferior; rectus internus only partially paralyzed; pupils normal; there was occlusion of the right posterior cerebral artery.

In connection with the above the following case is of interest, although there was no autopsy. There was some cause of irritation acting upon the nerve tract for the left limbs, the spasm being that which has been named "early contraction." We cannot doubt that the same irritating lesion caused the conjugate deviation to the right; as the limbs were in a state of spasm, we must conclude that the ocular muscles were also in spasm. The contraction of the ocular muscles was relaxed during sleep or coma; it is not stated whether the same was true as to the limbs.

From these symptoms we must conclude that the lesion was in the pons. Its nature is less clear. As the first attack was probably from embolism, it is probable the second arose from embolism also.

When the contraction was diminishing the right eye was directed upward and outward, the left eye was almost straight. The position assumed by the right eye has been referred to a lesion of the middle cerebellar peduncle, especially if the other eye is directed downwards and outwards.

CASE V. RIGHT HEMIPLEGIA AND APHASIA; PARTIAL RECOVERY; PERSISTENT SPASMODIC CONTRACTION OF LEFT LIMBS; CONJUGATE DEVIATION TOWARDS THE RIGHT; DEATH; NO AUTOPSY.

Minnie L., aged thirty-seven, entered hospital November 23d. She had had rheumatism about four years

[1] Zeitschr. f. Heilkunde, ii., 1881, p. 301.

previous; dyspnœa and palpitation on exertion for some time. Three days before admission, on awaking, she could not talk so as to be understood. That afternoon, on trying to rise from a chair, she found that the right arm and leg were paralyzed. She was sure she did not lose consciousness, and that her face was not drawn to one side. She regained partial use of leg and power of speech.

On examination there was seen to be slight paralysis of the right side of the face, tongue was protruded to the right. The upper branch of the seventh was not affected, both eyes closed readily, and the forehead was raised naturally on both sides. There was entire paralysis of the right hand and arm. She could move the right foot, though not so strongly as the left. Reflex actions were retained. Sensation did not seem to be materially impaired in either hands or feet. There was a loud double murmur connected with the aortic sounds, and enlargement of the heart. There were fine râles at the base of the left lung behind.

So far this is a simple case of embolism stopping up probably the left middle cerebral artery. The only other point of interest in the early history is that the evening temperature continued steadily above 101° F. until a week after entrance, November 30th, when it fell to 100° F.; and on December 2d to 99.4° F. It is not unlikely that the pulmonary complication kept this temperature up. She improved, gaining control over the right arm and more motion in the right side of her face.

December 2d. At evening visit she was found by the house officer to have lost the power of speech, the left fore-arm was contracted in flexion on the arm; both eyes were turned to the right. The right arm and leg moved very freely.

December 3d. At the visit she was lying with both eyes closed as if asleep. When the lids were raised there was slight external strabismus of right eye, the left eye being directed forward. When fully roused

the conjugate deviation to the right returned with slight nystagmus of a rotatory character. The pupils were about medium size, reacted so little to light it was difficult to decide whether they varied in size or not. Her jaws were firmly closed. The left arm was spasmodically flexed at the elbow, and strongly adducted, and passive motion was resisted. The fingers and hand were kept semi-flexed, but did not resist passive motion. The left leg was extended, passive motion at the knee was less free than on the right. Reflex action was absent on the left, present on the right. Sensation to pinching was retained in the face and hands. She moved the right arm slightly at the elbow during the examination, also the hand and fingers when they were irritated. She answered no questions, but gave response to what was asked by motions. When left to herself she relapsed into a comatose condition, and the eyes took the position noticed at the beginning of the examination.

She became gradually more stupid, could not be induced to take food by the mouth, and was fed per rectum.

December 7th and 8th the contraction of the arm was somewhat less strong, and the conjugate deviation less constant, though returning when she was aroused. During December 12th and 13th there was still less contraction, and she began to take milk by the mouth; on the 14th, taking a pint and half, and on the 15th, a quart. The right eye was then directed upwards and outwards; the left eye slightly inward, almost straight. Contraction of the left arm was much diminished.

December 16th. She took a quart of eggnog and retained two enemata, each consisting of one egg beaten up with pepsin.

December 17th. At 2.45 P. M. she died.

In the first of the above cases the conjugate deviation was towards the paralyzed side away from the lesion, as it should be theoretically. In the second case the same is true as to the conjugate deviation and the le-

sion, but the paralysis or weakness was exceptionally on the same side with the tumor. The ocular symptom was more trustworthy for localization than the paresis. In the third case both the conjugate deviation and the paralysis were intermittent. If the spot of softening found in the pons can be considered proof of serious disturbance in the circulation of that side before the last days of life, the symptoms in this case also followed the rule. In the fourth case the conjugate deviation was more marked on the day before death than previously; the other ocular symptoms led to a diagnosis which proved correct. At the autopsy the nucleus of the third nerve was cut into so that the microscopic examination was not perfectly satisfactory, as sufficient sections could not be made to be certain of the condition of that nucleus.

Conjugate deviation of the eyes may then, judging from these cases, be regarded as a localizing symptom. When the eyes are turned away from the lesion and towards the hemiplegic side, there is reason to believe the pons is affected; if, however, there is spasm, the eyes will be turned away from the affected limbs if the lesion is in the pons. Bernhardt[1] says that when there is paralysis of the abducens on the same side with tumor, combined with paresis of the opposite internal rectus, not fugitive but persistent, even without paralysis of the facial, it is a *certain* sign for lesion of abducens nucleus on the same side with the paralyzed rectus externus.

Many cases have been collected by Grasset, Hammond, and Bernhardt; experiments have been made by Duval and Laborde, which all show that the above symptom is as constant and safe for localizing as any others.

Wernicke[2] has reported a most interesting observation. There was paralysis of the left facial in all its branches, conjugate deviation of the eyes to the right,

[1] Beiträge zur Symptomatologie und Diagnostik der Hirngeschwülste. 1881, page 210.

[2] Ein Fall von Pseudobulbärparalyse. Arch. f. Psych. u. Nervenk., vii., 1877, p. 513.

sensation was diminished on the right side of the face. There was no paralysis of the limbs as to either sensation or motion. A tumor projected into the fourth ventricle, which extended on the left of the median line from one and one half centimetres above the calamus to one centimetre below the corp. quadrig. The longitudinal fibres of the pons and medulla were not affected. Both third nuclei and right sixth nucleus were not affected. The left sixth nucleus and the left sixth and seventh nerves were diseased. This observation was made before the commissural fibres from the sixth nucleus to the third nerve were established. Wernicke's interpretation of this case was therefore not quite correct. He refers the conjugate deviation to a lesion of a coördinating centre for the third and sixth nerves, which he locates near the nucleus for the sixth.

The symptoms connected with lesion of the nucleus of the third nerve, if carefully observed and rightly interpreted, are also localizing symptoms. The two cases reported by Kahler and Pick are of value as proofs of this. Wernicke[1] has given three cases of hæmorrhage into the gray substance about the third ventricle and the aqueduct of Sylvius, where the ocular symptoms were prominent.

The conclusion must then be formed that the study of the motions of the eye is of great value as aid in localizing the lesion.

It would be easy to extend this paper by considering the value of isolated paralysis of the abducens nerve, and by reports of other cases where there was no autopsy, but this would not be profitable.

[1] Lehrbuch der Gehirnkrankheiten, ii., p. 233.